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DIRECTORATE OF PLANT PROTECTION, QUARANTINE & STORAGE
MINISTRY OF FOOD AND AGRICULTURE, GOVERNMENT OF INDIA

# PLANT PROTECTION BULLETIN

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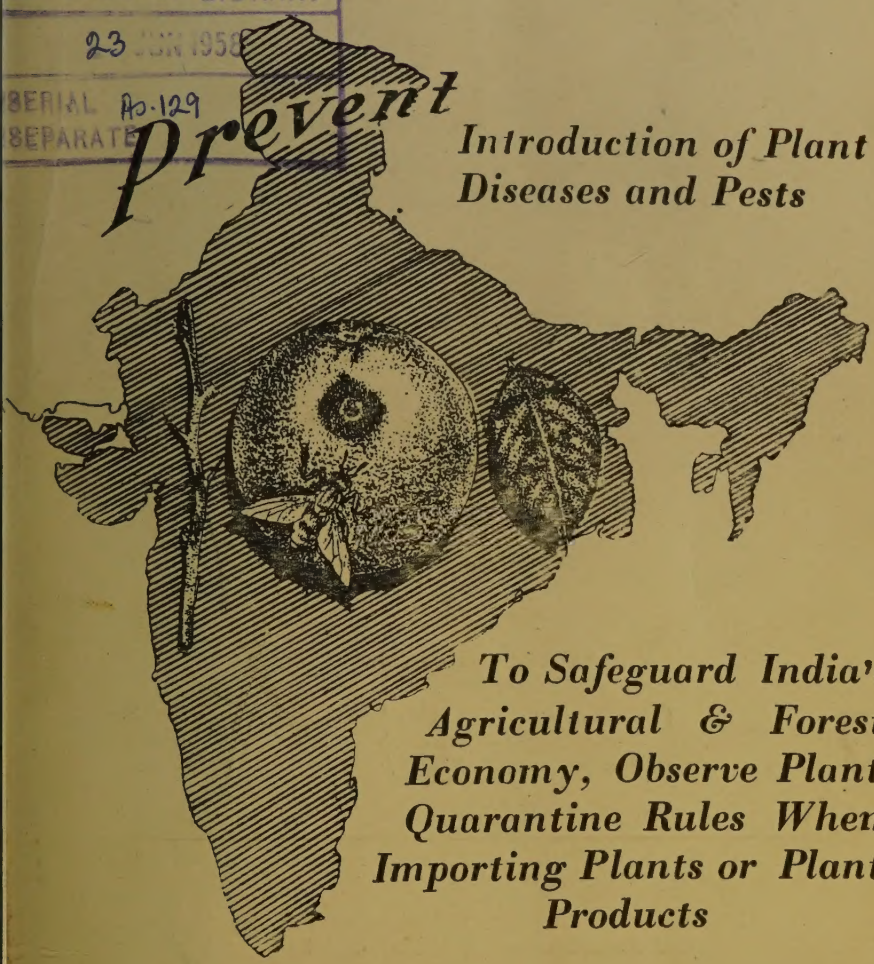
## Prevent Introduction of Plant Diseases and Pests



## To Safeguard India's Agricultural & Forest Economy, Observe Plant Quarantine Rules When Importing Plants or Plant Products

ISSUED BY THE PLANT PROTECTION ADVISER TO THE GOVERNMENT OF INDIA, NEW DELHI

**Published Quarterly**

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## NOTE

This Bulletin is intended to disseminate information about plant protection measures and campaigns adopted or conducted in different parts of India as well as about the advances made in the field of plant protection in other parts of the world to the extent possible. It is also intended to give information about the latest developments in the production of pesticides, plant protection equipment and techniques of pests and plant disease control. Elaborate scientific papers on Entomology or Plant Pathology or on the Chemistry of pesticides would normally not be in place in this Bulletin but short notes dealing with the behaviour or distribution of pests and plant diseases and brief reports on their epidemiology, control, etc., would be welcome. Plant protection has now become such a specialised science and yet is so diversified and consequential in its character and application that it is difficult to define the scope of the subject with any great precision. The general rule to be observed is that any information which can be useful in preventing or controlling damage to crops, fruit trees, plantations and stored agricultural commodities caused by pests and diseases should be a fit subject for publication in this Bulletin.

Manuscripts submitted for publication in the Plant Protection Bulletin must be typed in double spacing on one side of the paper only leaving ample margin on the left, at the bottom and on the top of the page. Photographs or drawings must be accompanied by a clearly typed legend which should appear under them. In addition, they should bear on their reverse in clear handwriting in pencil the name or names of the author or authors and the article which they illustrate. While this Directorate will take every care to include only such material in the Bulletin as may be considered reasonably correct and useful, it can accept no responsibility for every statement made and every opinion expressed.

Due to various unavoidable reasons the appearance of this Bulletin has been far behind the scheduled time. While this must be greatly regretted, every effort would be made to avoid delays in future. Those who may read this Bulletin are invited to offer criticisms and suggestions for its improvement.

K.B. Lal
Plant Protection Adviser
to the Government of India

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# PREVENTING PLANT DISEASE INTRODUCTION IN INDIA

By

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The first legislative step for preventing the introduction of plant diseases in India was taken in the year 1914, when an Act "to prevent the introduction into and the transport from one province to another in British India of any insect, fungus or other pest, which is or may be destructive to crops" came into being[1]. The rules as framed and amended from time to time under this Act have intended to exclude certain specific diseases of some of our crops like, potato, citrus, sugarcane and rubber plantations. Seeds are allowed free entry, except in the case of cotton, flax, berseem, coffee, rubber, Mexican jumping beans and sunflower. Fresh fruits, vegetables and other articles imported for consumption except fruits and vegetables from Afghanistan by air have also been exempted.

Khan[3] expressed the urgent need for reviewing our Act and the rules framed thereunder as early as in 1942 and indicated several drawbacks therein. Pruthi[11] pointed out that the intentions of the Act have not been fully realised mainly because the Customs personnel responsible for its enforcement were mostly non-technical people, having little or no knowledge of entomology or plant pathology. In the case of plant diseases, the difficulty has been still greater, as often they may remain latent and undetectable in the plant materials at the time of imports.

There are many diseases which are considered to have been introduced in India during the last few decades (Appendix I). The damage they cause depends upon the extent of cultivation of the crop concerned, special or routine measures adopted for their control, or for the control of other diseases already existing in the country etc., etc. There are many others which are yet unknown here, or are of a limited distribution or whose causal organisms may have more virulent strains elsewhere (Appendix III), and should evidently be prevented from entering our country. In this article some aspects of plant disease problem relating to quarantines are discussed in the light of existing regulations and certain methods which may be employed in this connection are suggested.

**Inspection of plants at the ports of entry.** Of the various ways of plant quarantine, inspection of plants at destination has not been considered to be very useful[5]. Its need is often questioned in India too, particularly when the plants are accompanied by a phytosanitary certificate from the country of origin. However, inspection at our ports is considered to be very essential for several reasons. Except in a very few cases provided for under the Act at present, where an inspection of the mother plants is required to be conducted in the country of origin and a special certificate appended to that effect, the exact pathological condition of the imported material is often obscure. This is particularly

true of virus diseases which are systemic and manifested mainly in the foliage or other plant parts during its growth. As a matter of fact, in such cases and other latent or internally borne diseases, 'detention' and/or 'Post-entry inspection', discussed below are also very necessary. Sometimes a disease may be in an incipient stage and remain undetected at the time of inspection in the exporting country. But during transit, it might develop and naturally surrender itself on a subsequent inspection at our ports. The same is true if even healthy plant material obtained from a disease-infected locality is packed inadvertently with diseased plant materials. Finally, the human element and the practical side of the problem, particularly when large consignments are involved, as indicated by McCubbin[5] also make an inspection at our ports very necessary, as it is not very unlikely that disease overlooked once might be detected on a subsequent inspection. Some of the fungi and bacteria intercepted on various types of plant materials imported through Bombay and Madras ports during the last two years or so, are listed in Appendix II. A perusal of this appendix will also indicate that not only the imported plants but also some other plants or their parts entrapped inadvertently during packing operations, may be responsible for the introduction of diseases.

**Detention and post-entry inspection**. As stated before, some diseases cannot be detected on a mere examination of planting materials immediately at the time of import. Where there is no inspection of the mother plants from which planting materials are derived, they must as a rule be detained and grown for a suitable period, sometimes one or two generations, in a quarantine house at the port. Later, if the plants so raised prove to be free from undesirable diseases, the progeny may be released ; otherwise the affected plants, or all those included in that consignment, depending upon the nature of the disease, should be destroyed forthwith and the soil, etc., in which the plants were grown suitably sterilised. This is, however, practicable only in case of small imports owing to limited space in quarantine houses and should be restricted to imports by the Government or other research institutions. In other cases, the importer should be required to grow certain specified materials, especially those which are known or suspected to carry injurious diseases, mostly viruses, in a prescribed locality, which should be well separated from the local flora of a similar or susceptible type. The plants should be kept under observation for a reasonable period, before their distribution to other localities is permitted. There are regular plant protection organisations in almost all the states now, which could assist in this work of post-entry inspection. In fact, all importers should notify the nearest plant protection centre, of any foreign plant arrivals in their own interest.

Further, the role of symptomless carriers in the introduction of destructive diseases should not be forgotten. Some special methods may have to be adopted at the ports to deal with them. For example, Dahlia corms infected with tomato-spotted-wilt virus may not exhibit distinctive symptoms themselves, but may serve as a source for the spread of this destructive disease to tomatoes. A simple and reasonably reliable procedure, based on the knowledge of the movement of the virus in the plant, may be adopted for the elimination of the disease. The corms may be grown under quarantine and as the virus is rather slow to travel upwards, cuttings may be taken from the top of the plant for further propagation. Another method which can be used in eliminating

suspected 'carriers' consists in inoculation from such plants to certain 'indicators' of a known history. In this way, yellows virus on sweet cherry or plum stock can be detected by budding on peach seedlings, which are not known to be infected by the virus in nature, but develop definite symptoms on artificial inoculation.

**Disinfection of soil, plants and packing materials.** Various plant parts used for propagation have been classed as the most dangerous means of introducing diseases in new localities by McCubbin[6] and any suitable treatment thereof should be undertaken at our ports. This may not, however, be necessary if the mother plants and the planting materials have been suitably treated before export. Certain methods employed in U. S. A. against diseases likely to be introduced on plant materials imported from abroad are summarised below, and some of these have already been adopted at Bombay and Madras ports. It should nevertheless be recognised at the very outset that some of these treatments are effective in complete elimination of pathogens, while others are only partially so and should merely be regarded as useful sanitary measures. As such, they differ from those used against insects where complete killing of the parasite is generally aimed at and achieved.

As a rule, soil should not be allowed to be brought in with plants as already pointed out by Pruthi[11]. If, however, it is brought, it should be carefully removed and sterilised before it is discarded. All other packing materials should also be treated likewise, particularly when they are not new, or when pathogens are found on the plant materials wrapped in them. The plants should later be suitably repacked before release.

1. *Steam pressure sterilisation.* Sterilisation with steam under pressure kills all organisms. This process is employed in the case of soil, packing material and plant materials not intended for propagation. An exposure at 20 lbs. pressure for 10 minutes, or 10 lbs. for 20 minutes is sufficient for loose masses of material, such as straw or bagasse. A longer time of 1—2 hours is necessary in the case of soil, depending upon its texture.

2. *Hot water treatment.* The specific methods for treatment with hot water vary considerably according to the parasite and the type of plant material concerned. For example, for the prevention of eelworm disease of Gladiolus, Narcissus, etc. (*Ditylenchus dipsaci* (Kuhn) Filipjev), the bulbs are pre-soaked in water at 75°F. for 2 hours, and then dipped in water at 110°—111°F. for 4 hours, while for eliminating mint rust (*Puccinia menthea* Pers.), the plants are submerged in hot water at 110°F. for 10 minutes. Peach cuttings can be cured of the yellows virus by immersing them in a bath of water at 122°F for 10 minutes. Roots of *Aloe variegata* L. and rhizomes of Calla lily are treated in hot water at 122°F. for an hour against *Phytopthora* root rot.

3. *Dry heat.* Dry heat is employed where steam or hot water treatment would cause injury to plant materials. The material is exposed for an hour to a temperature of 212°F which is lethal for most organisms. Plant material loosely packed can be readily reached by air. Hot air at 250°F. usually brings the lethal temperature within 15-20 minutes. Dry soil, on the other hand, even if it is spread thinly requires double this period on account of its poor rate of heat absorption and low inherent conductivity.

4. *Mercuric chloride.* Mercuric chloride is used in an aqueous solution of 1:1000 strength, though for special conditions weaker or stronger solutions may be employed. Four ounces of the powder in 30 gallons of water gives the standard strength for large scale applications. It is a good surface sterilising agent, but since it does not penetrate readily it is ineffective for internal disinfection. It may also kill tender host tissue quickly, and is safer only for hardier plant parts, such as bulbs, tubers and seeds. Living plants should be thoroughly washed in water after treatment. Against various surface infections of potato (*Rhizoctonia solani* Kuhn. *Actinomyces scabies* (Thax.) Gussow, *Spongospora subterranea* (Wallr.) Lagerh., *Spondylocladium atrovirens* Harz. and *Synchytrium endobioticum* (Schilb.) Perc.), all visibly affected tubers may be removed and the rest dipped in 70% alcohol, to ensure complete wetting, followed by immersion in water for 1 minute, to replace the alcohol, and in mercuric chloride solution for 90 minutes. Afterwards, the tubers are rinsed in water and dried.

Mercuric chloride solution should better be prepared afresh every time as it is weakened by use. The chemical is a deadly poison, and should be handled with care, and treatment of materials meant for human or animal consumption should be avoided.

5. *Formaldehyde.* Formaldehyde has a special fungicidal value, but it is also occasionally phytotoxic like mercuric chloride. Its use is largely restricted to dead materials, or to living plant parts well protected by cuticle. The material is soaked in a solution of 1 pint of the commercial formalin (37-40%) in 30 gallons of water (or 1 part in 240) for 1 to 1½ hours. In the case of true Gladiolus smut (*Urocystis gladioli* (Reg.) W.G.Sm.), the corms showing any infection are destroyed while the rest are soaked in the above solution for 1 hour.

Formaldehyde may be used in any container, but the treatment should be conducted in a ventilated place, as the fumes are injurious if inhaled for long. Skin irritation on hands may be avoided by the previous application of grease or by using rubber gloves.

6. *Hot Formaldehyde.* The use of hot formaldehyde is aimed at reducing the time of treatment and at the same time intensifying fungicidal action. For potato tubers, 1 pint formalin in 15 gallons of water heated to 124°-126°F. is used as a soak for 3-4 minutes. A special adaptation of this method is sometimes used in the treatment of Narcissus bulbs ; formalin is added to hot water, at the rate of 1 pint to 35 gallons, which eliminates both the nematode (*Ditylenchus dipsaci*) and the basal rot organism (*Fusarium bulbigenum* Cooke and Mass.).

Hot formaldehyde, 1 part to 200 parts of water, is also used for treatment of sugarcane cuttings against many fungi. For dormant canes, the treatment is given at 52°C. (126°F.) for 15-20 minutes ; sprouted cuttings are treated at 49°C.(120°F.) for the same duration.

7. *Dry Formaldehyde.* Dry Formaldehyde treatment is useful for the disinfection of small lots of very loose and open material. The chemical does not penetrate plant tissues to any appreciable extent.

A mixture of formalin (1 : 1) is sprayed as a fine mist so as to reach, without visibly wetting, all parts of the material. After application, the material is held in a tightly closed space, at room temperature, for 6-8 hours or overnight.

This method is also employed for disinfection of containers or other enclosed spaces, using formalin at the rate of 1 oz. per 100 cft. of space, when the temperature is 65°F. or above.

8. *Copper sulphate.* A solution of copper sulphate in water (1 lb. in 8 gallons) is used only as a surface disinfectant for certain seeds and inert materials. It may also be used as an alternative to formaldehyde solution. As it leaves a poisonous residue, it is less desirable than formalin and is not used for tender tissues owing to its corrosive nature.

9. *Bordeaux mixture.* Standard, 1% Bordeaux mixture (5 lbs. copper sulphate, 5 lbs. lime and 50 gallons water), or 0·8% (4 lbs. each of copper sulphate and lime in 50 gallons water), is used as a dip or spray, the latter being more effective. For example, in cases of slight leaf infections of 'scorch' disease on *Azalea* (*Septoria azalae* Vogl.), orchid rusts (*Uredo* and *Hemileia* spp.) and *Pyracantha* scab (*Fusicladium pyracanthae* Thum.), the affected leaves are removed and the plants sprayed thoroughly with standard Bordeaux mixture. The plants are then quickly dried and repacked. In case of young shrubs, suspected of contamination with crown gall (*Agrobacterium tumefaciens* (E.F. Sm. and Towns.) Conn.), the plants are treated by dipping in a strong solution of Bordeaux mixture (1½ lbs. copper sulphate, 3 lbs. lime and 2 gallons water).

Bordeaux mixture should be freshly prepared before use or any good proprietary product may be used to overcome inconveniences of preparing the former.

10. *Lime sulphur.* Lime sulphur solution is used as a dip or spray in the case of dormant woody plants and cuttings, 1 part of stock solution (1 part lime, 2 parts sulphur, 1 part water) diluted with 8 to 10 parts of water is generally employed, while in the case of plants with foliage, the dilution is at least 1 to 40. Quick drying is desirable after the treatment.

Lime sulphur is not poisonous or corrosive, and may be stored in any container. It is also valuable as a scalicide.

11. *Hydrogen peroxide.* Hydrogen peroxide is available commercially as a 3% solution in water. It is not injurious to plant tissues and is also not poisonous and corrosive, though as good a disinfectant as mercuric chloride. It is chiefly used in case of citrus seeds against canker (*Xanthomonas citri* (Hasse) Dowson): the seeds are immersed in a mixture of 1 part of the commercial preparation to 2 parts of water for 10 minutes and then dried without washing.

12. *Sulphuric acid.* Concentrated sulphuric acid is employed in the treatment of cotton seed against surface borne organisms, principally those of angular leaf spot (*Xanthomonas malvacearum* (E.F. Sm.) Dowson) and anthracnose (*Glomerella gossypii* (Southworth) Edg.). Delinting is more or less a convenient indication of effective disinfection and after this is achieved, the seeds are drained and washed in running water for 1 hour, the remaining traces of acid being neutralised later by dipping in 5% solution of sodium carbonate. The seeds are dried before repacking.

A modification of this treatment, known as Weston treatment, is used to disinfect seeds of corn, or related plants, against downy mildews (*Sclerospora* spp.). The seeds are dipped in 70 to 80% alcohol, drained

and, while still damp, immersed in concentrated sulphuric acid for 5-10 minutes (stirring from time to time). Further treatment is same as in case of cotton seed.

Sulphuric acid should be used in glass or earthenware. Adequate precautions should be taken in view of its highly corrosive action on clothing and skin. A supply of 10% solution of potassium or sodium hydroxide should be kept ready for use in cases of emergency. The waste acid should also be neutralised before it is discarded.

13. *Organic fungicides*. Various organic fungicides are also now available. Most of them are, however, specific and are used in individual cases to avoid seed injury or other objectionable effects which sometimes accompany treatment with other materials such as formaldehyde and mercuric chloride. They should not be regarded as general purpose disinfectants and should be used in accordance with recommendations for certain prescribed cases. For the control of basal rot (*Fusarium bulbigenum*), for instance, Narcissus bulbs are dipped for 2 minutes in a solution of 2% Ceresan (1 lb. in 8 gallons water), or New Improved Ceresan (1 lb. in 40 gallons water), and rapidly dried after treatment. Gladiolus corms are dipped in 5-10% Semesan or Uspulun at 50°C. for 15 minutes, against hard rot and dry rot (*Septoria gladioli* Pass. and *Sclerotinia gladioli* Drayt.), respectively. Similarly cuttings of certain ornamentals are treated in Semesan (1 oz. in 3 gallons water) for 30 minutes against various infections.

**Import of seed**. As already mentioned, under the existing D.I.P. Act, importation of seeds of sunflower from Argentina and Peru and Mexican jumping beans is prohibited, while seeds of flax, berseem, cotton and coffee may be imported by sea under special permits. All other seeds are allowed unrestricted entry.

Orton[7] has enumerated numerous diseases which are transmitted through seeds in various ways. Their importance in the spread of diseases to new areas has been discussed in detail by Porter[10]. A few fungal diseases, such as foot rot of rice and flag smut of wheat, have apparently been introduced into India through seed. Patel[9] considers several bacterial diseases to have come into India with seed from the West. Recently[2], a serious bacterial disease of tomato (*Corynebacterium michiganense* (E.F. Sm.) Jensen), has been reported from Madhya Pradesh, which is an apparent introduction through seed.

In view of the above it is not advisable to allow unrestricted entry of seeds of various plants, which must be treated in much the same way as any other propagation material, and should be subject to inspection and treatment at the port of entry. Further, their import should be permitted only in limited quantities to ensure proper quarantine action.

**Import of consumable articles**. Any processed or tinned food does not constitute danger of introducing diseases, and may be freely imported. However, the imports of cereals, fresh fruits and vegetables do deserve some attention. Padwick and Uppal[8], while discussing certain aspects of inter-state quarantines in this country, have remarked that "there is no guarantee that goods meant for consumption will not be used for propagation". The same holds true in regard to foreign imports as well. Martin[4] has also traced the spread of *Phytophthora*

*infestans* (Mont.) de Bary, to a tomato crop from diseased tomato fruits sold locally.

It would thus appear that some undeliberate actions of the expected consumers, such as careless disposal of rejected cereals, diseased peels of fruits and rotten vegetables, might sometimes result in the introduction of some unwanted foreign diseases, particularly if this happens to be done in the vicinity of susceptible crops. Pruthi[11] has already stated that any cultivation at or near the airports must be prohibited as such areas can serve as centres of infection. In addition to that, all garbage from the ships or planes should be carefully disposed off. Similarly, care should be taken in discarding any undesirable stuff which is known to be of a foreign origin.

An inspection of baggage of all passengers arriving from foreign countries should also be undertaken and steps taken to destroy even plant materials intended for consumption if they are found to be diseased.

**Packing materials and labelling of plants**. At present there are no specific regulations requiring any proper labelling of plants offered for import, or the use of any approved packing materials, with the result that in many cases the correct identity of the plant material is not known, and even cereal straw and husk are sometimes used for packing.

Only materials such as peat moss, sphagnum, excelsior (wood wool), saw dust, ground cork, coconut, or other vegetable fibres freed of pulp (excluding sugarcane and cotton fibre) should be employed for packing plant materials. Leaves, forest litter, wood moss, dried grass, weeds, hay and straw should not be used for this purpose.

All plant materials intended for import should be cleaned and precisely labelled, both as regards their identity (name of botanical species, variety, etc.) and quantity. Different types of plants should be packed separately. This would not only ensure a quick inspection and disposal at the ports, but is also important from the point of view of checking the entry of any undesirable plants.

**General considerations**. Under the conditions obtaining in India at present and with the object of ensuring least interference with the trade when facilities for the import of plants are being extended. it is not advisable to impose very rigid restrictions on the import of plant materials. Their entry should, however, be regulated through a central agency. As a rule, they should be accompanied by a phytosanitary certificate from the country of origin, if such facilities exist there, and should be subjected to inspection and treatment at our ports before entry. In cases where a phytosanitary certificate is not furnished for reasons considered genuine by the inspection staff, the latter should be authorised to use their discretion, when absolutely necessary such as in case of perishables, with regard to the release of consignments.

Complete prohibition of imports should be resorted to only in extreme cases, where the entry of diseases sought to be excluded can not effectively be checked by any other known methods. Even such materials may be allowed to be imported in small quantities by government or other institutions engaged in research but they should be grown in strict quarantine for a suitable period.

The import of plants which requires some special certificates of free-

dom from specified diseases, such as potato, citrus, sugarcane and rubber under the present terms of the D.I.P. Act, should also be restricted in quantity. However, larger imports of such materials may be permitted subject to a thorough check-up at the port of entry and a compulsory post-entry inspection.

At all ports, through which the entry of plant materials is channelised, adequate facilities for their inspection, treatment, etc., should be provided. On the other hand, plant materials requiring any special treatments should only be permitted for import through those ports where such facilities exist.

The plant quarantine personnel at all the ports should be kept well informed of the latest developments in plant pathology, particularly with regard to the distribution of diseases, methods of their detection, transmission and control and varietal resistance. This is necessary in order to ensure efficient functioning of the whole organisation.

The need for a very close co-operation between the plant quarantine officials and the various State Plant Pathologists, and other experts, cannot be over emphasised. There should be regular and well planned plant disease surveys in all the States under the control of the Plant Pathologists, who should be on the look-out for any new disease. This would help in proper promulgation of quarantine regulations which should be suitably framed, revoked or modified, whenever necessary.

Lastly, but not the least important, is the need for intensive propaganda to make the common man realise the importance of plant diseases and quarantines, and to keep him informed of the various rules and regulations framed in this connection from time to time, through newsreels, newspapers, posters and radio broadcasts.

The usefulness of plant quarantines on the whole is a much disputed question. If worked judiciously, it is an advantageous undertaking, which must be adopted both in our own and international interests. To quote Stakman[12] "That the laws should be suitable, well considered and strictly enforceable is of the greatest importance, for attempts to control plant diseases and insect pests by this means have often been brought into disrepute, because the laws sometimes have been enacted without sufficient consideration of the biology of the diseases, of the enforceability of the laws or because they have been enforced with unpardonable laxity or unnecessary severity. Therefore, many people including some scientists are opposed to plant protective legislation. Of course, it is just as unfair to condemn plant quarantines as it would be to condemn seed treatment, spraying, the use of resistant varieties and other disease control measures because they are not perfect. The really important thing is to organise and operate quarantines intelligently and effectively."

**Literature cited**


(1) Annonymous (1952) Destructive Insects and Pests Act 1914 (II of 1914) and the rules made thereunder by the Central Government—28 pp. Manager of Publications, Government of India, Delhi.

(2) Jain A.C. (1951) A bacterial disease (canker) of tomatoes new to India. Sci. and Cult., XVII, 1 : 46-47.

(3) Khan, A.R. (1942) Legislation against plant pests and diseases. Indian Fmg., III, 5 : 269-272.

(4) Martin, W.J. (1950) The role of fresh market tomato fruits in the dissemination of *Phytopthora infestans*. Plant Dis. Reptr. XXXIV, 8 : 236.

(5) McCubbin W.A. (1936) Analysis of typical plant diseases from the quarantine stand point. Phytopathology, XXVI : 991-1006.

(6) McCubbin W.A. (1946) Preventing Plant disease introduction. Bot. Rev., XII : 101-139.

(7) Orton, C.R. (1931) Seed borne parasites. A bibliography. W.Va. Agric. Exp. Sta. Bull. 245.

(8) Padwick, G.W. and Uppal, B.N. (1940) The problem of interprovincial plant quarantines in India. Indian J. Agri. Sci., X, 5 : 58-61.

(9) Patel M.K., Abhyankar S.C., and Kulkarni Y. S. (1949). Black rot of Cabbage—Indian Phytopathology, II, 1 : 58-61.

(10) Porter, P.H. (1941) Seed borne organisms and plant quarantines. J. Econ. Ent., XXXIV, 4 : 543-548.

(11) Pruthi, H.S. (1949) Fumigation and other methods of disinfestation of plant materials at ports. Indian J. Agric. Sci. XIX, 3 : 1-69.

(12) Stakman, E.C. (1931) Observations on plant quarantines. From translation of "Die Bedentung eines Pflanzen-schutzgestzes fur die Europaischen Lander", published in Mitt Der Deutschen Landwirtschafts Sesellschaft, Stuck 24 to 25.

## Appendix I

*Certain diseases believed to be introduced into India from foreign countries*

| | Disease | Host | Date of first record | Introduced from | Present distribution and damage caused in India |
|---|---|---|---|---|---|
| 1. | Leaf disease (*Hemileia vastatrix* Berk & Br.) | Coffee | 1879 | Ceylon | Travancore, Madras and Coorg ; causes good deal of losses. |
| 2. | Late blight (*Phytophthora infestans* de Bary) | Potato, tomato | 1883 | Europe | Now endemic in parts of northern India. |
| 3. | Rust (*Puccinia carthami* Roze) | Chrysanthemum | 1904 | Japan or Europe(?) | South India. |
| 4. | Flag smut (*Urocystis tritici* Koern.) | Wheat | 1906 | Australia | At least two per cent damage in the Punjab and Uttar Pradesh. Also known to occur in Madhya Pradesh and Rajasthan. |
| 5. | Downy mildew (*Plasmopara viticola* (B.&C.) Berl. & de Toni) | Grape vine | 1910 | Europe (?) | Practically co-distributed with the host and often a limiting factor in grape production. |
| 6. | Downy mildew (*Pseudoperonospora cubensis* (B. & C.) Rost.) | Cucurbits | 1910 | Ceylon | Occurs in several parts of India and causes appreciable losses. |
| 7. | Downy mildew (*Sclerospora philippinensis* Weston) | Maize | 1912 | Java | Throughout India ; affects yields considerably when severe. |
| 8. | Foot rot (*Fusarium moniliforme* var. *majus* Sheldon) | Rice | 1930 | South East-Asia(?) | At least 5% damage in Uttar Pradesh and Madras. Also known in some other States. |
| 9. | Leaf spot (*Phyllachora sorghi* v. Hoehn.) | Sorghum | 1934 | South Africa | South India. |

| | | | | | |
|---|---|---|---|---|---|
| 10. | Powdery mildew (*Oidium heveae* Stein.) | Rubber | 1938 | Malaya (?) | South India ; sufficient damage. |
| 11. | Black shank (*Phytophthora parasitica* Dast. var. *nicotianae* Tuck.) | Tobacco | 1938 | Dutch East Indies | Madras ; causes fair amount of destruction. |
| 12. | Fire Blight (*Erwinia amylovora* (Burr.) Wins. et al) | Pear and other pomes | 1940 | England | Uttar Pradesh. |
| 13. | Crown-gall and hairy root (*Agrobacterium tumefaciens* (Sm. & Towns.) Conn. & *A. rhizogenec* (Riker et al) Conn.) | Apple, pear | 1940 | England | Uttar Pradesh. |
| 14. | Bunchy Top (virus) | Banana | 1940 | Ceylon | Some doubt has recently been expressed about the true identity of the disease. Travancore, Bombay, Orissa. |
| 15. | Canker (*Sphaeropsis malorum* Berk.) | Apple | 1943 | Australia | Mysore. |
| 16. | Wart (*Synchytrium endobioticum* (Schilb) Perc.) | Potato | 1953 | Netherlands | Noticed once in a small area at Rangbul Farm, Darjeeling, West Bengal, in an imported variety of potato. Affected crop destroyed. |

## APPENDIX II

*Certain fungi and bacteria intercepted on plant materials imported through the ports of Bombay and Madras*

| S. No. | Organism | Host | Origin of Host | Whether phytosanitary certificate accompanied the plant material | Remarks |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| 1. | *Dimerosporium* sp. | *Agapanthus* sp. | New Zealand | Yes | |
| 2. | *Macrophoma* sp. | *Citrus* sp. | French Guiana | No | Severe infection noticed ; plant material destroyed. |
| 3. | *Botrytis* sp. | *Gladiolus* sp. | Holland | Yes | Common interception |
| 4. | *Phyllosticta* sp. | ,, | ,, | ,, | Certain bulbs exhibited severe infection. |
| 5. | *Septoria gladioli* Pass. | ,, | ,, | ,, | |
| 6. | *Stromatinia gladioli* (Drayton) Whetzal | ,, | ,, | ,, | |
| 7. | *Bacterium marginatum* Mc Cull | ,, | ,, | ,, | |
| 8. | *Spongospora subterranea* (Wallr.) Lagerh | *Solanum tuberosum* L. | Scotland | ,, | |
| 9. | *Thielaviopsis basiocola* (Berk. & Br.) Ferraris | *Gloxinia* sp. | Belgium (Via U.K.) | ,, | |
| 10. | *Phoma chrysanthemicol* Hollos | *Chrysanthemum* sp. | Holland | ,, | Appeared on plants grown in-quarantine |
| 11. | *Fusarium solani* App. et. Wr. | *Morus* sp. | Japan | ,, | Root rot |
| 12. | *Sphaeropsis dryobalanopsis* Srivastava sp. Nov. | *Dryobalanops aromatica* Gaertn. | Malaya | ,, | On seeds |
| 13. | *Macrophoma* sp. | ,, | ,, | ,, | ,, |

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| 14. | *Aspergillus niger* van Tiegh | *Gossypium* sp. | Sudan | No | Isolated from discoloured seeds. |
| 15. | *Botryodiplodia theobromae* Pat. | *Hevea brasiliensis* Mull. Arg. | Malaya | Yes | Associated with a seed rot in several shipments. |
| 16. | *Agrobacterium tumefaciens* (E. F. Sm. and Towns.) Conn. | *Rosa* sp. | England and Ireland | ,, | Galls, apparently of a bacterial origin, on roots. |
| 17. | *Sphaceloma* sp. | ,, | Australia | No | |
| 18. | *Botrytis* sp. | *Tulipa* sp. | England | ,, | |
| 19. | *Aspergllius* sp. | Cactaceae (?) | U.S.A. | Yes | Associated with a heart rot. |
| 20. | *Cryptosporella viticola* Shear | *Vitis* sp. | ,, | ,, | |
| 21. | *Ascochyta* sp. | ,, | ,, | ,, | |
| 22. | *Pestalotia* sp. | ,, | ,, | ,, | |
| 23. | *Phoma* sp. | *Vitis* sp. ? | Ceylon | ,, | On an unlabelled cutting. |
| 24. | *Diplodia* sp. | ? | Ceylon | No | On a twig of an unlabelled plant included with plant material imported for botanical study. |
| 25. | *Ascomycete* ? | ? | ,, | ,, | On a twig imported with dried plants (*Aerva* sp.) |
| 26. | *Verticillium dahliae* Kleb (?) | *Dahlia* sp. | England | Yes | A fairly severe infection. |
| 27. | *Phyllosticta* sp. | *Hevea* (?) | Malaya | ,, | On leaves, along with rubber seeds, as contamination. |
| 28. | *Phomopsis* sp. | ,, | ,, | ,, | |
| 29. | *Colletotrichum* sp. | ,, | ,, | ,, | |
| 30. | *Alternaria* sp. | *Nicotiana* sp. | Japan | No | Unmanufactured tobacco leaves. |
| 31. | *Cercospora* sp. | ,, | ,, | ,, | |

## APPENDIX III

*Some important plant diseases, yet unknown to exist, or of limited distribution in India*

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*Host Index and Distribution*

*Abies* spp. (including *A. balsamea* Mill., *A. cephalonica* Loud., *A. concolor* (Gord. & Glend.) Hoopes, *A. lasiocarpa* (Hook) Nutt., *A. nordmanniana* Spach etc.,) (Fir).

| | |
|---|---|
| *Bifusella faulii* Darker<br>United States of America. | Needle cast |
| *Calyptospora goeppertiana* J. Kuehn<br>Russia, United States of America. | Rust, Cluster-cup disease |
| *Chrysomyxa abietis* (Wallr.) Unger<br>Europe. | Needle rust |
| *Melampsorella cerastii* (Pers.) Schroet<br>Bulgaria, Canada, Turkey and perhaps other parts of Europe. | Rust, 'Witches broom' |
| *Pestalotia hartigii* Tub.<br>Norway. | Conifer seedling disease |
| *Phacidium infestans* Karst<br>United States of America. | Snow blight of conifers |
| *Phomopsis pseudotsugae* Wilson<br>Europe. | Canker |
| *Rehmiellopsis balsameae* Waterman<br>United States of America. | Needle blight |
| *Rehmiellopsis bohemica* Bub. and Kab. (=*R. balsameae*)<br>Bohemia, Canada, Czechoslovakia, Scotland, United States of America. | On young foliage and trees |

*Acer* spp. (including *A. campestris* L., *A. negundo* L., *A. platanoides* L. etc.) (Maple).

| | |
|---|---|
| *Cryptostroma corticale* (Ell. and Ev.) Gregory and Waller<br>England, France, North America. | Sooty bark |
| Maple—variegation virus,<br>Bulgaria, England, France, Germany, Japan. | |
| *Nectria galligena* Bres.<br>America, Europe. | Canker |

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|---|---|
| *Xanthomonas acernae* (Ogawa) Burk. Japan. | Leaf disease |
| *Aleurites* spp. (including *A. fordii* Hemsl. and *A. montana* Wilson etc.) (Tung). | |
| *Myscosphaerella aleuritidis* Ou. China, Brazil, French Equatorial Africa, Malaya, Trinidad. | Leaf spot |
| *Septobasidium aleuritidis* Heim & Bouriquet Madagascar. | |
| *Septobasidium pseudopedicellatum* Burt. United States of America. | Brown felt (on scale infested branches) |
| *Allium* spp. (including *A. cepa* L., *A. ascalonicum* L., *A. sativum* L., *A. porrum* L. etc.) (Onion, garlic, leek, shallot, etc.) | |
| *Botrytis allii* Munn and other species Several places in Europe, America and Australia. Also in China, Japan and South Africa. | Bulb rot, neck rot, flower blast |
| *Colletotrichum circinans* (B.) Vogl. Australia, Britain, Greece, Palestine, United States of America. | Smudge |
| *Peronospora destructor* (Berk.) Casp. Several places in America, Aurtralasia, Europe, and in China, Japan, Palestine, Iraq and South Africa. | Downy mildew |
| *Pyrenochaeta terrestris* (Hansen) Gorenz *et al.* Bermuda, South Africa, United States of America. | Pink root rot |
| *Stromatinia cepivorum* (Berk.) Whetzel Australia, Britain, Colombia, Italy, North America, Russia, South Africa. | White rot |
| *Urocystis cepulae* Frost Europe, Japan, New Zealand, Queensland, Russia, United States of America. | Smut |
| Yellow dwarf virus Several parts of Europe, Colombia (?), New Zealand, United States of America. | Stunting and yellowing of plants |
| *Brassica* spp. (including *B. oleracea* Linn. and its varieties) (Cabbage, cauliflower, mustard, turnip, etc.) | |
| *Colletotrichum higginsianum* Sacc. Jamaica, United States of America. | Leaf spot |

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|---|---|
| *Fusarium oxysporum* Schl. f. *conglutinans* (Wr.) Snyder and Hansen<br>United States of America, Belgian Congo, Cameroons, Southern Rhodesia, China (?), France, Holland, Cuba, (?) Trinidad. | Cabbage yellows |
| *Phoma lingam* (Fr.) Desm.<br>Australia, Canada, China, Europe, Japan, Hawaii, Kenya, Palestine, Philippines, Russia, New Zealand, South Africa, United States of America. | Black leg, leaf spot, stalk rot |
| *Chrysanthemum* spp. (Corn-marigold, daisy, pyrethrum) | |
| *Agrobacterium tumefaciens* (E.F. Sm. and Town.) Conn.<br>Several places in Europe and United States of America. | 'Crown gall' |
| *Corynebacterium fascians* (Tilford) Dowson<br>England, Germany, Sweden, United States of America. | 'Fasciation' |
| *Deuterophoma* spp.<br>United States of America. | 'Stunt' (?) |
| *Mycosphaerella ligulicola* Baker, Dimock and Davis<br>United States of America. | 'Ray blight' |
| *Ramularia bellunensis* Speg.<br>Belgian Congo, England, Italy, Kenya, Tanganyika. | Bud blight |
| Tomato Aspermy virus<br>England. | Destortion and dwarfing of flowers |
| Tomato spotted wilt virus<br>Australia, Britain, United States of America. | Some varieties are even carriers of this virus |
| *Vialina radicicola* Curzi<br>Cherso Island (Italy) | Root rot |
| Virus—strain of cucumber mosaic virus<br>Holland. | Chrysanthemum strain |
| Virus—(Curly=top-beet, yellow dwarf-potato)<br>United States of America. | |
| *Cinchona* spp. | |
| *Dasyscypha warburgiana* P. Henn<br>Indonesia. | Canker |
| *Elsinoe cinchonae* Jenkins<br>Central and South America. | Scab |
| *Phyllosticta* spp.<br>Indo-China and Indonesia. | On leaves causing defoliation |

*Citrus* spp. (including all Citrus hosts)
(Orange, lime, lemon, grape-fruit etc.)

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|---|---|
| Cancrosis B (a bacterial disease)<br>Argentina, Paraguay, Uruguay. | |
| *Bakerophoma tracheiphila* (Petri) Ciferri<br>Cyprus, Greece, Italy, Palestine, Sicily, Turkey, Russia. | 'Mal Secco' |
| *Elsinoe australis* Bitanc. and Jenkins<br>Argentina, Brazil, Eritrea, Paraguay, Uruguay. | Sweet orange scab |
| *Guignardia citricarpa* Kiely<br>Australia, South Africa. | Black spot disease |
| *Pseudomonas syringae* van Hall<br>Argentina, Australia, Cyprus, Greece, Italy, Japan, Palestine, Russia, South Africa, Sicily, Tunisia, New Zealand, United States of America. | Defoliation, twig blight scab |
| *Phytophthora hibernalis* Carne<br>Fiji, Palestine, Portugal, South Australia, United States of America. | Fruit rot |
| Seedling Yellows virus<br>New South Wales (Australia) | |
| Stem pitting and/or Tristeza root rot virus or quick decline virus<br>Argentina, Belgian Congo, Brazil, New South Wales, South Africa, Uruguay, U. S. A., Gold Coast, Madagascar, Peru. | |

*Coffea* spp. (Coffee)

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| *Colletotrichum coffeanum* Noack<br>Kenya. Also in India, but there appear to be some other strains causing different diseases in Kenya. | Brown blight, Coffee berry disease |
| *Gibberella xylarioides* Heim and Saccas<br>Belgian Congo, Ivory Coast. | Tracheomycosis |
| "Mal de talluelo"<br>El Salvador | Small stem disease (?) |
| *Omphalia flavida* (Maubl. and Rangel) Singer<br>North and South America, West Indies. | Leaf and berry spot |

*Dahlia* spp.

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|---|---|
| *Agrobacterium tumefaciens* (E. F. Sm. and Towns). Conn.<br>England, Queensland, Denmark. | Crown Gall |
| *Corynebacterium fascians* (Tilford) Dowson<br>England. | Fasciation of shoots |

Tomato spotted wilt virus
Australia, Belgium, England, Holland, Southern Rhodesia, United States of America.

*Gladiolus* spp.

*Botryotinia draytoni* (Buddin and Wakef.) Seaver — Corm rot
Britain, United States of America.

*Botrytis gladioli* Kleb. — Corm rot
Canada, England, Germany, Holland, New South Wales.

*Fusarium oxysporum* Schlecht. f. *gladioli* (Massey) Synder and Hansen — Storage rot
Australia, Britain, Canada, Holland, United States of America.

*Pseudomonas marginata* (McCull) Stapp — Scab and neck rot
Australia, Europe, North America.

*Septoria gladioli* Pass. — Hard rot
England, Germany, Holland, United States of America.

*Stromatinia gladioli* (Drayton) Whetzel — Dry rot
Australia, Europe, North America.

*Gossypium* spp. (Cotton)

*Colletotrichum gossypii* South. var. *cephalosporioides* A. S. Costa — 'Ramulosis'
Brazil.

*Fusarium javanicum* Koord. var. *radicicola* Wr. — Reported as causing a wilt of *Solanum tuberosum* in India
French Equatorial Africa, U. S. A.

*Fusarium neoceras* Wr. and Rkg. var. *subglutinans* (Wr. and Rkg.) Raillo
French Equatorial Africa.

*Fusarium scirpi* Lamb. and Fautr. *filiferum* (Preus) Wr.
French Equatorial Africa.

*Hevea* spp. (Rubber)

*Alternaria* sp. — Leaf blight
Mexico.

*Corticium* sp. — Arcolate leaf spot
Brazil, Indo China

*Melanopsammopsis ulei* (P. Henn) Stahel — South American Leaf disease.
Central and South America.

*Oidium heveae* Steinm. — Leaf fall.
Belgian Congo, Ceylon, Indonesia, Malaya, also known in India but more virulent races perhaps occur elsewhere.

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|---|---|
| *Pellicularia filamentosa* (Pat.) Rogers<br>Bolivia, Brazil, Costa Rica, Honduras, Peru, United States of America. | Target leaf spot |
| *Sphaerostilbe repens* B. and Br.<br>Belgian Congo, Burma, Ceylon, Dutch East Indies, French Indo China (?) Malaya, Uganda. Recently recorded in Assam (?) | Stinking root disease |
| *Xanthomonas manihotis* (Arthaud-Berthet) Starr<br>Brazil. | Bacteriasis |
| ***Hordeum*** **spp. (Barley)** | |
| *Claviceps purpurea* (Fr.) Tul.<br>Australia, Canada, Europe, United States of America.<br>Reported on some other hosts in India | Ergot |
| *Rhynchosporium secalis* (Oud.) J.J. Davis<br>Argentina, Europe, Tanganyika, United States of America. | Scald, leaf blotch |
| False stripe Virus-Seed borne<br>United States of America, Canada. | |
| *Xanthomonas translucens* (Jones, Johns & Reddy) f. sp. *hordei* Hagborg<br>Russia, United States of America. | Bacterial stripe |
| *Ipomoea batatas* (L.) Lam. (Sweet potatoes) | |
| *Ceratostomella fimbriata* (Ellis and Halst.) Elliot<br>North America | Black rot |
| *Elsinoe batatas* (Saw) Veigas and Jenkins<br>Brazil, Guam, Japan, United States of America. | Stem and foliage scab |
| *Fusarium* spp.<br>United States of America. | Surface rot, stem rot, wilt etc. |
| Internal cork virus<br>United States of America. | |
| *Monilochaetes infuscans* Ell. & Halst. ex Harter<br>Azores, Brazil, Hawaii, Japan, New South Wales, Queensland, Sierra Leone, United States of America. | Scurf |
| Viruses (including Dwarf virus, witches' broom virus and an unidentified virus)<br>Japan, Java, Kenya, Tanganyika. | |
| *Juglans* spp. (Walnut)— | |
| *Exosporina fawcetti* Wilson<br>United States of America. | Branch wilt, Canker |

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|---|---|
| *Gnomonia leptostyla* (Fr.) Ces. and de Not<br>Holland, Yugoslavia and probably other parts of Europe. | Brown blotch of leave |
| *Xanthomonas juglandis* (Pierce) Dowson<br>Argentina, Bermuda, Canada, Chile, China, Europe, North America and South Africa. | Bacterial blight |
| ***Linum usitatissimum*** L. (Flax and Linseed) | |
| *Colletotrichum linicola* Pethybr. and Laff.<br>Abyssinia (?), Argentina, Australia, Canada, Europe, Formosa, Japan, Peru, Russia, United States of America. | Seedling blight |
| *Cuscuta* spp. (including *C. epilinum* Weihe)<br>Europe, United States of America. | |
| *Kabatiella lini* (Laff.) Karakulin<br>Canada, Europe, Japan, New Zealand, Russia, United States of America. | Stem break and browning |
| *Mycosphaerella linorum* (Wr.) Garcia Rada<br>Argentina, Canada, Denmark, Germany, Hungary, Ireland, Kenya, New South Wales, New Zealand, Peru, Queensland, Rumania, Russia, United States of America. | Pasmo disease, defoliation |
| *Phoma* spp. (including *P. exigua* Desm. & *P. lini* Pass.)<br>Australia, Czechoslovakia, Denmark, Germany, Great Britain, United States of America. | Foot rots |
| ***Lycopersicum esculentum*** Mill. (Tomato) | |
| *Colletotrichum atramentarium* (Berk and Br.) Taub.<br>Several places in Australia, Europe and America. Recorded on potato in India too. | Wilting and death of plants |
| *Colletotrichum phomoides* (Sacc.) Chester<br>Britain, United States of America. | Ripe rot (Anthracnose) |
| *Corynebacterium michiganense* (E. F. Sm.) Jensen<br>Several places in Australia, Europe, North America, Africa and Turkey. Recently recorded in India (Madhya Pradesh). | Bacterial canker |
| *Didymella lycopersici* Kleb.<br>Austria, Channel Islands, Denmark, England, Germany. | Stem rot, fruit rot |

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|---|---|
| *Phoma destructiva* Plowr.<br>Britain, Israel, Queensland, United States of America, Yugoslavia. | Fruit rot, also on stems and leaves |
| *Septoria lycopersici* Speg.<br>Argentina, Bermuda, Bolivia, Britain, Canada, Hawaii, El Salvador, Mozambique, Madagascar, Queensland, United States of America, Yugoslavia, Belgian Congo. | Leaf blight |
| Tomato spotted wilt virus.<br>Several places in Australia, Europe and America and probably other countries. (The virus is not known to be transmitted through the seed but it is known to infect many other hosts, including various ornamentals and may be introduced in India through them). | |
| *Xanthomonas vesicatoria* (Doidge) Dowson<br>Argentina, Australia, Canada, Japan, Palestine, South Africa, United States of America. Recorded in India on *Capsicum* spp. | Scab, bacterial spot, canker |
| ***Morus*** **spp. (Mulberry).** | |
| *Agrobacterium tumefaciens* (E.F.Sm. & Towns.) Conn.<br>Turkey, Russia. | Crown gall |
| Dwarf or curl virus.<br>Japan, Central Asia. | |
| *Pseudomonas mori* (Boyer and Lambert) Stevens<br>Australia, Brazil, Europe, Italian East Africa, Japan, Russia, Tanganyika, Tasmania. | Bacterial blight |
| *Sphaerella morifolia* Pass.<br>Brazil, Spain, Turkey, Western Australia. | 'Mulberry leaf rust' |
| ***Musa*** **spp. (including *M. paradisiaca* L. and *M. sapientum* L.) (Banana, plantain)** | |
| Bunchy top virus.<br>Ceylon, Egypt, Fiji, Japan, Australia. Also reported in India but a doubt has since been expressed as to its identity (*in litt*). | Dwarfing, yellowing and death of plants. |
| *Calostilbe striispora* (Ell. and Ev.) Seaver<br>Belgian Congo, Central America, Jamaica. | Bonnygate disease |

*Collybia semi-usta* (Berk and Curt.) Dennis — Stem and root rot
Brazil, Ceylon, Fiji, Hawaii, Jamaica, Malta, Mauritius, Philippines, Sierra Leone, the Antilles, Trinidad, Uganda.

*Fusarium oxysporum* Schelcht f. *cubense* (E.F.S.)Wr. — Panama wilt
Several parts of the world. Also known in India in certain places.

Infectious chlorosis virus (?)
Philippines.

*Nigrospora sphaerica* (Sacc.) Mason — Squirter disease
Eritrea (?) Jamaica (?) New South Wales, Queensland.

*Sphaerostilbe repens* B. and Br. — Root-disease
Belgian Congo.

*Verticillium theobromae* (Turc.) Mason and Hughes — Cigar-end disease
Australia, Central America, Italy, GoldCoast, South America, Tanganyika.

*Narcissus* spp. (Daffodil etc.)

*Botryotinia narcissicola* (Greg.) Buckwald — Smoulder
Europe, United States of America.

*Botryotinia polyblastis* (Greg.) Buckwald — Narcissus fire
Great Britain, United States of America.

*Ditylenchus dipsaci* (Kuhn) Filipjev — Eelworm disease
England, Holland.

*Fusarium oxysporum* Schl. f. *narcissi* Snyder and Hansen — Basal rot
Britain, Canada, Holland, United States of America.

*Ramularia vallisumbrosae* Cav. — White mould
Canada, Denmark, France, Great Britain, Italy, Norway, Portugal, Sicily Islands, United States of America.

*Stagonospora curtisii* (Berk.) Sacc. — Leaf scorch
Western Europe, North and South America.

Stripe virus.
America, Bermuda, Bulgaria, Denmark, England, Holland.

*Nicotiana* spp. (Tobacco)

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| *Peronospora* spp. (including *P. tabacina* Adams, *P. hyoscymi* de Bary *P. nicotianae* Speg.) Argentina, Australia, Brazil, Canada, Europe, Malaya, South Africa, United States of America. | Blue moulds |
| *Pseudomonas angulata* Fromme and Murray Holland, Canada, Nyasaland, Philippines, Rhodesia, South Africa, Tanganyika. | Angular leaf spot, black fire |
| *Pseudomonas tabaci* (Wolf and Foster) Stevens. Argentina, Brazil, Europe, Mozambique, New Zealand, Philippines, South Africa, United States of America, Venezuela. | Wild fire |
| Virus diseases (including those caused by Tobacco necrosis virus, Tobacco Ringspot virus, Tobacco Yellow ringspot virus, Tobacco streak virus, Tobacco Yellow dwarf virus etc.) Australia, Brazil, Britain, Canada, United States of America. | |

*Olea europaea* L. (Olive)

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|---|---|
| *Cycloconium oleaginum* Cast. Africa, Argentina, Chile, Palestine, Western Europe, United States of America. | Leaf blotch |
| Progressive decline (virus) (?) Argentina, Brazil, Italy, Portugal (?), Sardinia, Spain. | |
| *Pseudomonas savastanoi* (E. F. Sm.) Sevens Argentina, Europe, Morocco, Palestine, United States of America, Yugoslavia. | Olive knot |

*Oryza sativa* L. (Rice)

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|---|---|
| *Puccinia graminis* Pers. var. *oryzae* Frag. Italy, Rumania, Spain. | |
| *Sclerophthora macrospora* (Sacc.) Thirumalachar, Shaw and Narasimhan Italy. (Reported from India on *Eleusine coracana* Gaertn. and also occurs on some other cereal hosts in Europe and America) | |
| *Xanthomonas oryzae* (Uyeda and Ishiyama) Dowson Japan. | Leaf blight. |

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| *Persea americana* Mill. (Avocado pear) | |
| *Botryosphaeria ribis* var. *chromogena* Shear *et al*.<br>Rhodesia, United States of America (The species and its variety both occur on several other hosts also in parts of Europe and America causing wilt and dieback of plants). | Branch canker, fruit rot |
| *Pseudomonas syringae* van Hall<br>South Africa, United States of America. | Bud blight, branch canker, fruit spot |
| *Sphaceloma perseae* Jenkins<br>Argentina, Brazil, Central America, North America, Peru, South Africa, West Indies. | Scab (fruit and foliage) |
| *Pinus* spp. (Pines) | |
| *Cronartium* spp. (including *C. asclepiadeum* (Willd.) Fr., *C. ribicola* Fischer, and numerous others).<br>Europe, Japan, North America, Russia. *C. ribicola f. indica* occurs in India. | |
| *Lophodermium pinastri* (Schrad.) Chev.<br>Europe and North America. The fungus occurs on *Picea excelsa* Link in India, but there are certain morphological differences. | Needle cast of Scots pine |
| *Melampsora pinitorqua* Rostrup<br>Europe. | Branch rust |
| *Scirrhia acicola* (Dearn.) Siggers<br>United States of America. | Brown spot |
| *Piper nigrum* L. (Black pepper) | |
| Bacterial disease (?)<br>Cambodia, Indo-China. | |
| *Cyphella* sp.<br>Sarawak. | |
| Leaf and stem mottle virus (?)<br>Cambodia, Indo-China. | |
| *Populus* sp. (Poplars) | |
| Bacterial canker (?)<br>England, Italy. | |
| *Dothichiza populea* Sacc. and Briard<br>North America, Western Europe. | Canker, die-back |
| *Melampsora larici-populina* Kleb.<br>Chile, Great Britain, Norway. | Rust, causes excessive defoliation |
| *Melampsora pinitorqua* Rostr.<br>Europe. | Branch Rust of Scots pine |

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|---|---|
| *Pseudomonas rimifaciens* Koning<br>Western Europe. | Bacterial canker. |
| *Venturia tremulae* Aderh.<br>Italy, Norway, United States of America. | Defoliation, Wilt and blackening of shoots |
| ***Prunus*** spp. (Including *P. amygdalus* Batsch., *P. armeniaca* L., *P. avium* L., *P. cerasus* L., *P. domestica* L., *P. persica* L. (Batsch., etc.) (Almond, Apricot, Cherry, Peach, Plum etc.) | |
| *Agrobacterium tumefaciens* (E. F. Sm. and Towns.) Conn<br>Several parts of Europe, Africa, America, Australia and some places in Asia. | Crown gall |
| *Cercospora circumscissa* Sacc.<br>Bulgaria, Iran, Turkey, United States of America. | Almond leaf blight |
| *Coccomyces heimalis* Higgins<br>Australia, Europe, North America, Iraq. | Cherry leaf spot |
| *Coccomyces prunophorae* Higgins<br>United States of America. | Plum leaf blight |
| *Coryneum carpophilum* (Lev.) Jauch<br>Several parts of the world. | Shot hole, canker, bud-blight, twig blight, fruit rot, scab |
| *Dibotryon morbosum* (Schw.) Theis and Syd.<br>North America, South Africa. | Black knot of Cherry and Plum |
| *Gnomonia erythrostoma* (Fr.) Auersw.<br>Western Europe. | Cherry leaf scorch |
| *Monilinia* spp. (including *M. fructicola* (Wint.) Honey, *M. fructigena* (Aderh. and Ruhl.) Honey and *M. La a* (Aderh. and Ruhl.) Honey).<br>Australia, Europe, New Zealand, North America. *S. cinerea* (Bon.). Schroet is reported to occur in India, but the identification of the brown rot organisms in the plains of India, in general, is said to require confirmation. | |
| Mora virus<br>United States of America. | On Cherry |
| *Nectria galligena* Bres.<br>Rumania. | European canker on Cherry |
| Peach viruses (including Little Peach, Peach Yellows, Peach X-disease, | |

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|---|---|
| Peach Mosaic, Peach Rosette and Phony Peach etc.)<br>Canada, Italy, United States of America, Yugoslavia. | |
| Pfeffinger disease (virus)<br>Switzerland. It has been reported that a virus disease of Cherry also occurs in England. | On Cherry |
| Plum stunt (? virus)<br>England. | On plum |
| *Pseudomonas mors-prunorum* Wormald<br>Several places in Europe, New South Wales. | Canker |
| *Pseudomonas syringae* van Hall<br>Australia, Europe, North America, South Africa (?), New Zealand. | Bud blight, canker |
| *Xanthomonas pruni* (E.F. Sm.) Dowson<br>Canada, New Zealand, Queensland, Sweden, United States of America. | Shot hole |
| *Pyrus* spp. (including *P. communis* L. and *P. malus* L.) (Pear, Apple) | |
| *Agrobacterium rhizogenes* (Riker *et al.*) Conn.<br>United States of America, also reported from Italy. | Hairy root of apple |
| *Agrobacterium tumefaciens* (E.F. Sm. and Towns.) Conn.<br>Several places in Europe, America, Australia, Africa and Asia. | Crown gall |
| *Erwinia amylovora* (Burrill) Winslow *et al.*<br>New Zealand, North America. Also perhaps other places in Europe and Asia and recorded in India too, in Uttar Pradesh. | Fire blight of pear |
| *Gymnosporangium* spp. (including *G. juni peri-virginianae* Schw., *G. tremelloides* R. Hartig, etc.)<br>Europe, China, Japan, North America, Turkey. | |
| *Leptosphaeria coniothyrium* (Fuckel) Sacc.<br>England, United States of America. | Canker, fruit rot |
| *Monilinia* spp. (including *M. fructicola* (Wint.) Honey, *M. fructigena* (Aderh. and Ruhl.) Honey and *M. Laxa* (Aderh. and Ruhl. Honey)<br>Australia, Europe, New Zealand, United States of America. | |

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| *Mycosphaerella pomi* Walton and Orton<br>New Zealand, United States of America. | Brook's fruit spot |
| *Nectria galligena* Bres.<br>Canada, Chile, Iran, Japan, New Zealand, South Africa, South Western Europe, United States of America. | European canker |
| *Neofabraea malicorticis* Jackson<br>Canada, Denmark, Holland, New Zealand, United States of America. | Black spot canker |
| *Neofabrae perennans* Kienholz<br>Australia, Canada, England, Tasmania, United States of America. | Perennial canker |
| *Nummularia discreta* (Schw.) Tul.<br>Cuba, Germany, Italy, United States of America. | Blister canker |
| *Phyllosticta solitaria* E. and E.<br>North America, also recorded in India (Bombay State (?), Uttar Pradesh.) | Apple blotch |
| *Physalospora obtusa* (Schw.) Cooke<br>Europe, New Zealand, United States of America. | Black rot, canker |
| *Pseudomonas syringae* van Hall<br>Australia, Europe, America, South Africa, New Zealand, United States of America. | Flower blast |
| *Venturia pirina* Aderh.<br>Australia, Europe, United States of America. | Pear scab |
| Viruses (includiug Apple mosaic virus, Pear stony pit virus)<br>Canada, England, Holland, New Zealand, United States of America. | |
| *Quercus* spp. (Oak) | |
| *Chalara quercina* B.W. Henry<br>Holland, United States of America. | Wilt |
| *Cronartium* spp.<br>Canada, United States of America. | |
| *Endothia parasitica* (Murrill) Anderson and Anderson<br>Italy, United States of America, Yugoslavia. Also known in India on *Castanea* sp. | Chestnut blight |

*Rosa* spp. (Roses)

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| *Agrobacterium tumefaciens* (E.F. Sm. & Towns.) Conn.<br>Several places in Australia, Europe and America. | Crown gall |
| *Botryosphaeria ribis* Gross. and Duggar var. *chromogena* Shear *et al.*<br>United States of America. | Cane blight canker |
| *Coniothyrium rosarum* Cooke and Harkness<br>United States of America. | Rose graft canker |
| *Coniothyrium wernsdorffiae* Laubert<br>Germany, United States of America. | Brand canker of roses |
| *Cryptosporella umbrina* (Jenkins) Jenkins and Wehmeyer<br>Britain, United States of America. | Brown canker |
| *Leptosphaeria coniothyrium* (Fuckel) Sacc.<br>Australia, China, Europe, Japan, Russia, South Africa, Uganda, Rhodesia. | Stem canker |
| *Phragmidium disciflorum* (Tode) James<br>Britain, Iceland, Switzerland, United States of America. | Rose rust |
| Viruses (including Cowl-forming virus, mosaic virus, streak virus and wilt virus).<br>Australia, Britain, Czechoslovakia, Italy (?), New Zealand, United States of America. | |

*Saccharum officinarum* L. (Sugarcane)

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| *Bacterium albilineans* Ashby<br>Australia, Brazil, British Guiana, Formosa, Fiji, Hawaii, Java, Japan(?) Mauritius, Madagascar, NewGuinea(?), Nossi-Be, Philippines, Reunion. | Java gum disease |
| Fiji disease (virus)<br>Australia, Fiji, New Britain, New Guinea, Java, Philippines, Samoa, Solomon Islands. | Severe stunting and death of plants |
| Root disease (a complex of several fungi and other factors)<br>Argentina, Australia, Brazil, Jamaica, Java, Puerto Rico, Reunion, Mauritius, West Indies and perhaps other countries. | |

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| Sereh disease (virus)<br>Brazil, Java, also reported from Australia, Borneo, Ceylon, Formosa, Indo-China, Malaya, Indonesia and Mauritius, but perhaps does not occur now. | Severe stunting and ultimate death of plants |
| *Xanthomonas vasculorum* (Cobb) Dowson<br>Australia, Brazil, British West Indies, Colombia, Mauritius, Puerto Rico. | Gummosis |
| ***Solanum tuberosum* L. (Potato)** | |
| *Corynebacterium sepedonicum* (Spieck. and Kotth.) Skaptason and Burkholder<br>Canada, Costa Rica, France, Germany, other parts of Europe, Jamaica, Switzerland, United States of America. Also reported on certain occasions from Uttar Pradesh in India but not confirmed. | Ring rot of tubers |
| *Heterodera schachtii* Schmidt<br>Europe, United States of America. | Golden nematode |
| *Phoma foveata* Foister<br>Great Britain. | Gangrene |
| *Phytophthora erythroseptica* Pethybr.<br>Bulgaria, France, Great Britain, Holland, Java (?), Sumatra, United States of America. | Pink rot of tubers |
| *Pseudomonas syringae* van Hall<br>England. | |
| *Spondylocladium atrovirens* Harz.<br>Several parts of the World. Reported from India too (*in litt.*). | Dry scab |
| *Synchytrium endobioticum* (Schilb.) Perc.<br>Several places in Europe, Canada, South Africa, Peru, United States of America. Recorded once in India (See Appendix I). | Potato wart |
| *Thecaphora solani* Barrus<br>Ecuador, Peru, Venezuela, Colombia. | Buba disease |
| Viruses (including Spindle tuber virus, Witches' broom virus, Tomato spotted wilt virus etc.)<br>Australia, Europe, North America. | |
| ***Theobroma cacao* L. (Cocoa)** | |
| Black heart disease (?)<br>Venezuela. | |

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| Die-back (?)<br>Colombia. | |
| *Crinipellis perniciosa* (Stahel) Singer<br>Brazil, Colombia, Equador, Grenada, Peru, Tobago, Trinidad, Venezuela. | Witches' broom |
| *Monilia roreri* Cif.<br>Colombia, Peru, Equador, Venezuela. | |
| *Ramularia necator* Massee<br>West Indies. | Cacao seed disease. |
| Swollen shoot virus<br>Gold Coast, Ivory Coast, Nigeria, Togoland. | |
| Virus (I R)—Seed transmitted<br>Algeria. | |
| *Trifolium* spp. (Clover) | |
| *Botrytis anthophila* Bondartzev<br>Europe, New Zealand, Tasmania, United States of America. | Affects flower and seed production. |
| *Colletotrichum destructivum* O'Gara<br>Europe, United States of America. | Anthracnose |
| *Colletotrichum trifolii* Bain and Essary<br>United States of America. | Southern anthracnose |
| *Cuscuta* spp.<br>Europe, United States of America. | |
| *Kabatiella caulivora* (Kirch.) Karak.<br>Europe, North America. | Anthracnose, scorch |
| *Triticum* spp. (Wheat) | |
| *Claviceps purpurea* (Fr.) Tul.<br>Britain and probably other parts of Europe and America. | Ergot |
| *Dilophospora alopecuri* Fr.<br>Several parts of Europe and North America. | Twist |
| *Pseudomonas atrofaciens* (Mc Cull.) Stevens<br>Australia, Canada, New South Wales, Russia, South Africa, United States of America. | Grain spot, basal glume or spikelet rot |
| *Sclerophthora macrospora* (Sacc.) Thirumalachar, Shaw & Narasimhan<br>Australia, Italy, Mexico, United States of America. | |
| *Xanthomonas translucens* f. sp. *cerealis* Hagborg<br>Australia, China, Europe, Kenya, North America, South Africa, Tanganyika. | Dwarfing of heads |

*Vitis* spp. (Grape vine)

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| *Agrobacterium tumefaciens* (E.F.Sm. & Towns.) Conn.<br>Austria, South Africa, United States of America. | Crown gall and canker |
| Apoplexy or Spanish or Black measles (associated with *Fomes igniarius* (L. ex. Fr.) Kick and *Stereum hirsutum* (Fr.) Fr)<br>Europe, South Africa. | |
| Court-noue virus.<br>Algeria, Greece, South Western Europe. | |
| *Cryptosporella viticola* Shear<br>Canada, South Africa, United States of America, Italy. | Dead arm |
| *Erwinia vitivora* (Baccarini) Du Plessis<br>Argentina, Austria, Canary Islands, France, Italy, Portugal (?), Sicily, South Africa, Switzerland, Spain (?), Tunis, Yugoslavia. | Mal nero, bacterial gummosis. |
| Pierce's disease (virus.)<br>United States of America. | |
| *Phakopsora vitis* (Thum.) Syd.<br>Central America, Ceylon, China, Colombia, Japan, Java, Philippines, United States of America, Venezuela, West Indies. (*Phakopsora cronartiiformis* (Barcl.) Diet. is recorded from Bombay State in India and the above mentioned rust is indicated as synonym of this, though without an authority.) | |
| *Physalospora obtusa* (Schw.) Cooke<br>South Africa, United States of America. | |
| Viruses (including mosaic virus, lucerne dwarf virus and perhaps those of distortion disease and witches'broom).<br>Argentina, North Western Europe, United States of America, South Africa (?) | |

*Zea mays* L. (*Maize*)

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| *Bacterium stewarti* E. F.Sm.<br>Italy, Mexico, Peurto Rico, Russia, United States of America. | Wilt |

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| *Cochliobolus heterostrophus* Drechs.<br>China, Gold Coast, Japan, North Caucasus, Philippines, United States of America. Its conidial stage, *Helminthosporium maydis* Nishikado and Miyake, has been recorded on *Zingiber officinale* L. in India. | Southern leaf blight |
| *Diplodia zeae* (Schw.) Lev.<br>Several places in Africa, Argentina, Brazil, Australia, North America. | Dry rot of maize |
| *Gibberella fujikuroi* (Saw.) Wr. and/or var. *subglutinans* Edwards<br>Several places in Africa, Argentina, Australia, Brazil, Central America, North America. The conidial stage *Fusarium moniliforme* Sheldon is reported to occur on certain hosts in India. | Stem and ear rot |
| *Gibberella roseum* (Link) Snyder and Hansen f. *cerealis* (Cooke) Snyder and Hansen<br>Argentina, Australia, Brazil, Canada, Europe, Rhodesia, Tanganyika, United States of America. | Ear blight or scab |
| *Helminthosporium carbonum* Ullstrup<br>South Africa, United States of America. | Charred ear mould and leaf spot |
| *Puccinia polysora* Underw.<br>Africa, United States of America. | Rust |
| *Sclerophthora macrospora* (Sacc.) Thirumalachar, Shaw and Narasimhan<br>Italy, United States of America (?). | |

# BRIEF REVIEW OF PLANT PROTECTION WORK IN MYSORE STATE DURING 1953-54

By

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During the year there was no serious outbreak of any insect pest on a large scale, but almost all the common insect pests and diseases made their appearance and in most of the cases warranted the adoption of control measures. The following is a resume of the general observations made on several pests and diseases of different crops.

**Paddy**

All the common insect pests, beetle, *Leptispa pygmaea* Baly ; caseworm, *Nymphula depunctalis* Guen.; grasshopper, *Hieroglyphus banian* Fab.; thrips, *Thrips oryzae* ; bug, *Leptocorisa acuta* Thun.; gall fly, *Pachydiplosis oryzae* Woodmason ; jassids, *Nephotettix bipunctatus* Fab. and to a very small extent rice hispa, *Hispa armigera* Ol. ; swarming caterpillar, *Spodoptera mauritia* Boisd. ; stem borer *Schoenobius bipunctifer* Wlk. appeared in one or the other district in the state. Of these, the case-worm, the grasshopper and the stem borer were predominent. The caseworm appeared throughout the state over an area of about 6,000 acres. This pest appeared equally in *Malnad* and *Maidan* areas. The stem borer appeared in patches all over the state and its incidence was mild. The grasshopper has shown a tendency to spread gradually in all the districts and was severe in patches. The, Leptispa beetle again appeared mostly in the *Malnad* (Shimoga Chickamagalur and Hassan) districts of the State. Out of a total area of about 13,215 acres infested by the pest, about 10,592 acres were treated. The paddy jassid appeared over an area of 400 acres in Shimoga district. *Piricularia oryzae* Cav. was fairly common in all the districts. Seed paddy was treated before sowing and this formed a routine operation.

**Ragi** (*Eleusine corocana*)

The *ragi* stem borer, *Sesamia inferens* Walker, appeared in fairly serious form in Shimoga, Mandya, Hassan and Chitaldrug districts and to a small extent in Kolar district. The cut-worm *Laphygma exigua* Hubner, was seen in large areas in Mysore and Chitaldrug districts. The Deccan grasshopper, *Colemania sphenarioides* Bol., which made a mild appearance in Chitaldrug district was observed to do slight damage to *ragi*. Blister beetle, *Mylabris pustulata* Thumberg, appeared over an area of about 60 acres in Shimoga district. Mosaic disease was observed in Kolar district. Aphis on *ragi* was associated with mosaic. About 1,541 acres were treated against the insect pests.

**Jola** (*Andropogon sorghum*)

A total of 5,962 acres was attacked by several insect pests. The hairy caterpillar, *Amsacta albistriga* Wlk., was the most serious pest having appeared in Shimoga district over an area of 1,825 acres. The earhead bug, *Calocoris angustatus* Leith., was prevalent in Mysore,

Mandya, Tumkur, Chitaldrug and in a very small area in Kolar districts, while the earhead webbing caterpillar, *Stenochroia elongella* Hampson, was present in the 4 districts of Mysore, Mandya, Chitaldrug and Shimoga. A stem borer, *Chilo zonellus* Swinhoe, was seen damaging the crop in Shimoga and Chitaldrug districts. The fly borer, *Atherigona indica* Malloch. was observed in Bellary district. The mite, *Paratetranychus indicus* Hirst, appeared in Chitaldrug district. 'Smut' on *Jola* was found over an area of 850 acres in Bellary district.

**Millets**

An area of about 1,224 acres under miscellaneous millets was infested by hairy caterpillar, *Amsacta albistriga* Wlk., army worm *Cirphis unipuncta* Haw., and surface grasshoppers.

These pests appeared in Chitaldrug district.

**Cotton**

Cotton in Chitaldrug district was attacked by the pests aphis—*Aphis gossypii* G., boll worms; *Platyedra gossypiella* and *Earias* sp., leaf-eating caterpillar, *Euproctis fraterna* Mo.; semilooper caterpillar, *Anomis flava* Fabricius appeared in Chitaldrug, Mysore and Shimoga districts. Jassid, *Empoasca devastans* Dist. appeared in Bellary district over a small area. The other pests though present were not found in a serious form.

**Sugarcane**

Stem borer, *Chilotraea infuscatella* Sn. appeared in Kolar, Shimoga and Chitaldrug districts. As a protective measure, light earthing up of plants was carried out in 190 acres. This measure of control has been a regular routine operation in Mandya district and the area covered is not included in this report.

**Groundnut**

The leaf-mining caterpillar, *Stomopteryx nerteria* M. was most virulent in Chitaldrug district although it was observed in Bangalore, Tumkur and Kolar districts also. *Aphis laburni* Kalt. was common in Chitaldrug and Bellary districts. The leaf curl disease was prevalent in Chitaldrug district.

**Castor**

Castor semilooper, *Achoea janata* L. appeared in almost all the areas in the State. The other pests were not serious.

**Pulses**

The most common insect pest on the pulses was *Heliothis obsoleta* F. which feeds on the pods and causes damage to the crops. The other insect pest which appeared in good numbers over an area of about 20 acres in Chickmagalur district was the blister beetle. About 266 acres were treated against these pests.

**Cocoanut**

The red ant *Solenopsis geminata* Fb. appeared in an area of about 1 acre in Mandya, Hassan and Chitaldrug districts. *Anabe Roga Ganoderma lucidum* was prevalent in Tumkur district over 300 acres.

**Arecanut**

In Tumkur district the crop suffered from the ravages of the scale

insect *Chionaspis dilatata* G. nearly as much as 290 acres being affected. The scale was also observed in Shimoga district over an area of 2 acres. *Anaba roga* was prevalent in Chitaldrug district, about 8 acres being affected by this disease.

**Citrus**

Citrus in Chitaldrug and Bellary districts suffered from deficiency diseases. The insect pests met with were the aphis, *Aphis tavaresi* Dg., and a few minor caterpillars, which were causing slight injury to the crop. An area of about 193 acres was protected from insect pests and diseases.

**Mango**

The mango-hoppers, *Idiocerus* spp. were the most common pests on mango. An area of about 121 acres was protected against this pest in the districts of Bangalore, Mandya, Chitaldrug, Chickamagalur, Shimoga and Bellary.

**Grape**

In addition to advising several private parties in protecting this crop at the time of pruning from ravages of flea-beetle, *Scelodonta strigcollis* Mots. an area of about 14 acres was treated to control this pest. The pest was reported mostly from the nearby *talukas* of Bangalore district. Mildew on grape was also reported from a small area in Bangalore district.

**Chillies**

The thrips *Scirtothrips dorsalis* H. was most common and prevalent over large areas in Kolar, Bellary, Chitaldrug and Tumkur districts. A small patch of about 2 acres in Bangalore district, suffered from the ravages of this insect. In Bangalore district the red ant—*Solenopsis geminata* Fb. appeared over an area of about 7 acres and was observed to cause wilting of young plants.

**Onion**

The onion thrips *Thrips tabaci* L., appeared over a large area of 682 acres in Kolar district. In Bellary and Chickamagalur districts the insect appeared over small areas. In Chitaldrug district, though the insect was frequently met with it did not appear over any appreciable area of the crop.

**Garlic**

The onion thrips, *Thrips tabaci* L., was found seriously affecting the garlic crop in Kolar district. An area of 206 acres was treated against this pest.

**Potato**

Potato blight appeared in Bangalore, Tumkur and Hassan districts. *Epilachna vigintioctopunctata* F., was common in all the potato growing areas. In addition to the large acreage treated by ryots as a routine agricultural operation, 82 acres were treated to control this pest. The red ant *Solenopsis geminata* Fb. was found over an area of 140 acres in Kolar district. Cutworm was observed over an area of 12 acres in Chickamagalur district.

**Miscellaneous vegetables**

About 871 acres under different vegetables were treated against various insect pests. Of the insect pests the prominent were epilachna on brinjal, aphis on peas and beans ; cutworms on tomato, leaf eating caterpillars on cabbage ; and thrips, aphids and jassids on most of the vegetables.

**Kakada**

The most common *kakada* mite or Jasmine mite, *Eriophys* sp., was present on *Kakada* in Bangalore district. The gardeners have practiced the usual method of control. In a new area one plot of one acre was protected from the ravages of the mite.

**Tobacco**

The aphis, *Mysus persicae* St. appeared in Mandya and Kolar districts. The cut-worm, *Prodenia litura* F. caused slight damage to the crop in Hassan and Kolar districts. Stem borer, *Gnorimoschema heliopa* L. was observed in Kolar and Mandya districts. Mildew appeared in Kolar district. The insects, though observed, were not found on extensive areas. 18 acres were protected from the insect pests.

**Sann-hemp**

About 222 acres of sann-hemp in Mandya and Chitaldrug districts were affected by the hairy caterpillar, *Utethesia pulchella* L. The crop was protected.

**Fruit plants**

Several insect pests on different fruit crops like pomegranate, *Sapota* and water melon were controlled and the crops were fully protected.

**Control Operations**

In most of the cases the standard methods of control were adopted as in previous years. BHC was used to a large extent mostly against insect pests of agricultural crops. Agrosan was used in treating seeds especially of paddy and *jola*, prior to sowing. Folidol was used against certain insect pests like aphis, bugs and in a small area against Epilachna. Other chemicals used in the control of insect pests and diseases of the crops mentioned above were, D D T 50% W. P., D D T 10% dust, *Hongey* oil soap, Sulphur, Calcium arsenate, Cynogas, Sodium silicofluoride, Transformer oil, Copper sulphate, Tobacco dust, Zinc sulphate, Zinc phosphide, Perenox and Fernoxone. A total quantity of 52,778 lbs. of chemicals was sold and Rs. 12,958 were realized. The cost of control operations against any one pest on a particular crop has been found to be variable not only in different districts but also in different places of the same districts. The data collected are being analysed and the general index showing the cost of control operations for each insect pest will be published.

**General**

Cyclic pests like Deccan Grasshopper, *jola* earhead pests, the *Kambli Hulas* on dry land crops, though made their appearance but were not serious as in previous years. The Coffee stem borer continued to maintain its severity of attack inspite of the adoption of the mechanical method

of control. Cardamom hairy caterpillar made its appearance on a small scale in Hassan district, but did not extend to other areas. Leptispa and thrips on paddy were severe in certain areas. Though paddy stem borer was present in all the areas it was found to be causing damage in a few places only and that too in patches.

The quantity of chemicals sold to the agriculturists indicates the growing tendency on the part of the agriculturists to take up control measures to protect their crops. But still most of them depend on the Plant Protection staff for pest and disease control operations and expect the Government to subsidise the supply of chemicals.

# CONTROL OF FIELD RATS IN HYDERABAD STATE

By

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Field rats are a serious menace to crops in Hyderabad State. Till recently rats have been causing damage mostly to *Kharif* crops but now even the *Rabi* crops are being severely affected. Six districts namely Bidar, Osmanabad, Gulbarga, Bhir, Parbhani and Raichur are having particularly serious rat trouble.

The damage to crops by rats is two fold :—(1) They dig out and eat the seeds sown in the soil. (2) The plants are cut at the base and grains eaten up. Groundnut suffers most when the pod-formation has been completed. The damage to *Kharif* crops is more than to *Rabi*. The damage to *Kharif* crops according to the cultivators' estimate is about 50%.

To control the rats on a large scale, a campaign was organised in Osmanabad, Gulbarga and Bidar districts in the year 1954. To start with, the cultivators were made familiar with the chemical that was to be used. Later, the campaign was organised with the co-operation of the cultivators, using Zinc phosphide bait in the proportion of 1 ounce of the chemical in 20 ounces of *jowar* or *bajra* flour. The bait was spread in the evenings in the fields at the rate of 500 pills per acre. One Plant Protection or Extension Field-worker was kept in charge of 6 villages for execution of the campaign which was supervised by Plant Protection Assistants. The bait was spread for two nights in every field. The pills were spread in the night and those not eaten up were collected and destroyed. Fresh pills were given every night. In all five tons of Zinc phosphide bait were used in the State for rat control. With one pound of bait about 500 pills were prepared. It has been observed that, on an average, there was a kill of one rat per pill. Thus there was a kill of 500 rats per acre. The campaign resulted both in the control of rats as well as in the education of farmers in rat control.

**Economics** :—Cost of spreading bait is about a rupee per acre. Estimating loss to *Kharif* crops at 20%, this measure saved 60 pounds of grain per acre. Five tons of the bait costing about Rs. 4,500/- were used to cover about 11,000 acres. Due to the adoption of this measure, 300 tons of grain were saved. In terms of money cultivators saved Rs. 90,000/-.